

Claims

1. A tilt-rotor aircraft comprising a fuselage, wings for sustained forward flight, and a plurality of rotors, each rotor being independently and sequentially tiltable between a position providing lift and a position providing propulsion for forward flight.
2. An aircraft according to claim 2 in which the rotors are mounted on or symmetrically about the centre-line of the aircraft.
3. An aircraft according to claim 1 or claim 2 in which the rotors are inclined to the roll axis of the aircraft, or to the pitch axis of the aircraft.
4. An aircraft according to claim 3 in which the angle of inclination is up to forty five degrees, preferably substantially twenty two and a half degrees.
5. An aircraft according to claim 3 in which the angle of inclination is variable.
6. An aircraft according to any of claims 1 to 5 in which the rotors are substantially in mesh.
7. An aircraft according to any of claims 1 to 5 comprising a mechanism for varying the relative phase of the rotors to permit sequential tilting.
8. An aircraft according to claim 7 in which the mechanism comprises a cross-shaft driving both rotors.
9. An aircraft according to any of claims 1 to 8 in which a tilt axis of the rotors is vertically or longitudinally offset from the point of convergence of the rotational axis of each rotor.

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10. An aircraft according to claim 9 in which the cross-shaft includes a differential gearbox.
11. An aircraft according to any of claims 1 to 10 in which the flight positions are to the rear of the fuselage.
12. An aircraft according to any of claims 1 to 11 in which the lift positions are substantially vertical or tilted toward the front of the fuselage.
13. An aircraft according to any of claims 1 to 12 in which in the forward flight position the rotors operate as pusher propellers.
14. An aircraft according to any of claims 1 to 13 operable in three flight modes, a first of which is used below a first air speed, a second of which is used between the first air speed and a second air speed, and a third of which is used above the second air speed.
15. An aircraft according to any of claims 1 to 13 comprising means for sensing dynamic air pressure arising from air speed, the aircraft being operable in three flight modes determined with reference to dynamic pressure, the first-mode being used below a first dynamic pressure, the second mode between the first dynamic pressure and the third mode above the second dynamic pressure.
16. An aircraft according to claims 14 or 15 in which the second flight mode is a compound mode, in which at least one of the rotors is in the flight position or at least one of the rotors is in the lift position.
17. An aircraft according to any of claims 14 and 15 in which the first air speed or first dynamic pressure is sufficient for the wings to provide substantially half of the aircraft lift.
18. An aircraft according to any of claims 14 to 17 in which the second air speed or second dynamic pressure is sufficient for the wings to provide substantially all

of the aircraft lift.

19. An aircraft according to any of claims 1 to 18 in which the rotors are moveable into a feathered position.
20. A tilt-rotor aircraft comprising a fuselage, wings for sustained forward flight, and front and rear rotors mounted on the aircraft fuselage for providing lift, at least one of the rotors being tilttable between a lift position and a position providing propulsion for forward flight.
21. An aircraft according to claim 20 wherein both rotors are tilttable between lift and propulsion positions.
22. An aircraft according to claim 20 wherein the other rotor is deployable to an autogyro configuration for forward flight, or can be folded in flight.
23. A tilt-rotor aircraft comprising a fuselage, wings for sustained forward flight, and at least one rotor tilttable between a position providing lift and a position providing propulsion for forward flight, the rotor or rotors being carried by supporting structure mounted on the fuselage and being disposed on or symmetrically about the longitudinal centre line of the aircraft.
24. A tilt-rotor aircraft comprising a plurality of rotors carried by at least one tilttable nacelle on the longitudinal centre line of the aircraft.
25. An aircraft as claimed in claim 23 of claim 24 comprising a pair of contra-rotating rotors which are coaxial, or on parallel axes, or intermesh.
26. An aircraft as claimed in any of claims 23 to 25 wherein a said nacelle or supporting structure is mounted to pivot and optionally also translate about an axis extending transversely of an upper part of the aircraft fuselage.

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27. An aircraft as claimed in any of claims 23 to 26 wherein the rotors are mounted above the fuselage on a nacelle moveable between a lift mode and a forward flight mode.
28. A tilt-rotor aircraft comprising a tiltable rotor assembly moveable between a lift position and a forward flight position in front of or behind the fuselage.
29. An aircraft as claimed in claim 28 wherein in the lift position the rotor assembly is below the fuselage of the aircraft.
30. An aircraft as claimed in claim 28 wherein in the forward flight position the rotor assembly operates as a pusher propeller.
31. A tilt-rotor aircraft as claimed in claim 28, 29 or 30 being also as claimed in any of claims 23 to 27.
32. A tilt-rotor aircraft as claimed in any of claims 28 to 31 being of a twin-boom layout, wherein booms extend from the wings of the aircraft to support the aircraft's empennage, the rotor assembly being disposed between the booms when the aircraft is in forward flight mode.
33. An aircraft as claimed in any of claims 23 to 32 wherein at least inboard portions of wings of the aircraft are moveable so as to present leading edges to the airflow generated from the rotors and motion of the aircraft.
34. A tilt-rotor aircraft comprising a tiltable rotor assembly on the longitudinal centre line of the aircraft moveable between a lift mode and a forward flight mode, inboard portions of the wings of the aircraft being moveable so as to present leading edges to the airflow generated by the rotor assembly in lift mode.

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35. An aircraft as claimed in claim 33 or 34 wherein a said moveable portion is rotatable and/or may be translated longitudinally or transversely about a fixed beam projecting from the fuselage of the aircraft.
36. An aircraft as claimed in 35 where the said fixed beam is offset from the tilt axes of the rotors.
37. An aircraft as claimed in claim 35 wherein the beam extends to a fixed outboard portion of the wing.
38. An aircraft as claimed in any of claims 33 to 36 wherein each wing has at least two substantially parallel moveable portions.
39. An aircraft as claimed in any of claims 33 to 36 wherein a said moveable portion is configured to act as a control surface when the aircraft is in lift mode and/or in transition between lift and forward flight modes, the aircraft also comprising control means for operating the control surface.
40. An aircraft as claimed in any of claims 23 to 39 wherein the underside of the fuselage is shaped to reduce download forces on the fuselage from the airflow generated by the rotor or rotors in lift mode.
41. An aircraft as claimed in any of claims 23 to 39 comprising a control surface on the fuselage, operative when the aircraft is in a lift mode and/or in transition between lift and forward flight modes.
42. An aircraft according to any of claims 1 to 22 and any of claims 27 to 42.
43. A tilt-rotor aircraft substantially as herein described with reference to Figures 1 to 4.

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44. A tilt-rotor aircraft substantially as herein described with reference to Figures 5 to 8.
45. A tilt-rotor aircraft substantially as herein described with reference to Figures 8 to 11.